



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/730,892	12/10/2003	Katherine L. Saenger	20140-00316-US	5181
30678	7590	11/08/2005	EXAMINER	
CONNOLLY BOVE LODGE & HUTZ LLP			GEYER, SCOTT B	
SUITE 800			ART UNIT	
1990 M STREET NW			PAPER NUMBER	
WASHINGTON, DC 20036-3425			2812	

DATE MAILED: 11/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/730,892	SAENGER ET AL.	
	Examiner	Art Unit	
	Scott Geyer	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 September 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-32 is/are pending in the application.
- 4a) Of the above claim(s) 17-32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 8, 10, 12 and 16 is/are rejected.
- 7) ☒ Claim(s) 6, 7, 9, 11 and 13-15 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 10 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

This application contains claims 17-32 drawn to an invention nonelected without traverse in Paper No. 042605. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1-5, 8, 10, 12 and 16 are rejected under 35 U.S.C. 102(a) as being anticipated by Mitsuhashi et al. (US 2003/0104706 A1).

As to **claims 1-5**, Mitsuhashi et al. teach a method of making an ultra-thin high-k gate dielectric. The high-k gate dielectric is deposited upon a substrate. The ultra-thin high-k gate dielectric is formed by thinning the deposited high-k gate dielectric material, and the resulting thickness is between 1 to 3 nm (see paragraphs 0001 through 0069). The high-k dielectric material is made of hafnium oxide. A conductive gate structure is formed on the ultra-thin high-k dielectric as noted in paragraphs [0055]-[0056].

As to **claims 8 and 10**, Mitsuhashi et al. teach damaging a top portion of the hafnium oxide layer and then etching away the damaged portion (see figures 3A-3D).

Art Unit: 2812

As to **claim 12**, Mitsuhashi et al. teach the high-k dielectric material to be used as the gate dielectric. Therefore, after the gate dielectric is formed, a plurality of subsequent steps (i.e. post-thinning steps) will be performed to complete the semiconductor device.

As to **claim 16**, Mitsuhashi et al. teach annealing the high-k dielectric layer prior to the thinning process (see paragraph 0043).

Allowable Subject Matter

Claims 6, 9, 11, 13 and 14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art of record and to the examiner's knowledge does not teach or render obvious, at least to the skilled artisan, the instant invention regarding:

depositing an interfacial layer of metal-free dielectric material between the substrate and the high-k dielectric material, as recited in claim 6;

using physical sputtering, ion beam etching, reactive ion etching or GCIB to remove the high-k dielectric material, as recited in claim 9;

utilizing an argon reactive ion etch as the damage treatment for the hybrid damage/wet etching treatment, as recited in claim 11;

a post-thinning treatment step of annealing in inert ambient, annealing in a reactive ambient and treating with plasma, as recited in claim 13;

adding additional material to the gate dielectric during or after the thinning step, wherein the material is from the group of material recited in claim 14.

Response to Arguments

Applicant's arguments filed September 8, 2005 have been fully considered but they are not persuasive. The applicant contends that Mitsuhashi et al. do not teach forming a conductive gate structure *after* a thinning process of the high-k dielectric layer. However, as noted in paragraph [0055] of Mitsuhashi et al., an anneal process is performed which compacts the hafnium oxide layer. As noted in Table 1 of the Ng et al. reference cited in the previous office action (mentioned here as a teaching reference), hafnium oxide decreases in thickness (i.e. is thinned) with thermal annealing. Therefore, Mitsuhashi et al. do teach thinning the high-k dielectric layer prior to formation of a gate electrode structure.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

Art Unit: 2812

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Scott Geyer whose telephone number is (571) 272-1958. The examiner can normally be reached on weekdays, between 10:00am - 6:30pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



11/4/05

Scott Geyer
November 4, 2005